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Ileostomy creation in colorectal cancer surgery: risk of acute kidney injury and chronic kidney disease

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ABSTRACT

Background: Ileostomy creation is associated with postoperative dehydration and readmission; however, the effect on renal function is unknown. Our goal was to characterize the impact of ileostomy creation on acute and chronic renal function.

Materials and methods: A retrospective cohort study with patients undergoing colorectal cancer surgery at a tertiary referral institution (2005-2011). The relationship between ileostomy creation and acute kidney injury (AKI)-related readmission, severe chronic kidney disease (CKD) at 12 mo (glomerular filtration rate <30 mL/min/1.73 m^2), and onset of severe CKD over time was evaluated using multivariable logistic and Cox regression and adjusted using propensity score stratification.

Results: Among 619 patients, 84 (13%) had ileostomy. AKI-related readmission and severe CKD at 12 mo were more common among ileostomy patients (17% *versus* 2%, $P < 0.01$ and 13.3% *versus* 5%, $P = 0.02$, respectively). After propensity score adjustment, ileostomy was a significant predictor of AKI-related readmissions (odds ratio: 10.3; 95% confidence interval [CI], 3.9-27.2), severe CKD at 12 mo (odds ratio: 4.1; 95% CI, 1.4-11.9), and onset of severe CKD over time (hazard ratio: 4.2; 95% CI, 2.3-6.6).

Conclusions: Ileostomy creation is associated with increased risk of AKI-related readmissions and development of severe CKD. Future studies must focus on strategies to minimize kidney injury when ileostomy is a necessary component of colorectal cancer surgery and revisiting current indications for ileostomy creation.

Introduction

Ileostomies are an important tool in the surgical management of patients with colorectal cancer (CRC). Indications include diversion to allow gastrointestinal output when restoration of the gastrointestinal tract is not safe and/or possible or as a palliative procedure to decompress a distal obstruction. Numerous studies have recommended ileostomy as a safe option for fecal diversion.[1–4] Because ileostomy use is associated with lower rates of clinically relevant anastomotic leak

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and is currently understood to have a low-risk profile, several studies recommend routine diverting ileostomy for patients undergoing low rectal surgery.[1,5,6] Moreover, ileostomies are recommended over colostomies because of advantages during time of stoma reversal, including lower wound infection rate, lower rate of incisional hernia, shorter hospital stay, and in general, a less invasive approach during the takedown operation.[3,7]

However, data show that potential complications after ileostomy creation can be substantial, including obstruction, hernia, and complications related to the stoma reversal procedure.[2,4,8] In fact, ileostomy creation has been reported to be associated with hospital readmissions after colorectal operations because of high ileostomy output, leading to dehydration and acute renal impairment[9]; however, there is lack of data examining the effect of ileostomy creation on short-term and long-term renal function.

Kidney disease is known to have an adverse effect on cardiovascular-related death and all-cause mortality rates.[10,11] Prior studies have shown that medical patients who sustained an increase in serum creatinine of 0.5 mg/dL had higher 30-d mortality rates.[12] Other studies have shown that even smaller increments in serum creatinine are associated with worse mortality overall.[13,14] The National Kidney Foundation Disease Outcome Quality Initiative described the severity of renal disease by stage according to discrete ranges of glomerular filtration rate (GFR).[15] In addition to increased overall mortality, patients with severe chronic kidney disease (CKD; defined as GFR of 15-29 mL/min/1.73 m^2) experience significant deterioration in their overall health and quality of life, as current guidelines emphasize changes in patient management, namely initiation of renal replacement therapy, such as dialysis or kidney transplant.[16]

Based on these considerations, the goal of this study was to evaluate the effect of ileostomy creation on acute kidney injury (AKI) requiring readmission and the long-term effect on renal function, specifically, development of severe CKD. To examine these associations, we used a prospective CRC database and collected additional patient-level data not available in large population level registries, including direct measures of renal function at specified time intervals.

Materials and methods

This was a retrospective study of patients having CRC surgery at the Michael E. DeBakey Veterans Affairs Medical Center in Houston, Texas; the study was approved by the Institutional Review Board of Baylor College of Medicine and by the Research and Development Committee of the Michael E. DeBakey Veterans Affairs Medical Center. A waiver of consent was approved given the retrospective nature of the design.

Study population and data collection

Patients undergoing surgery for CRC–related disease were included in the study (2005-2011). Patient data were extracted from Veterans Affairs electronic medical records and entered in a prospective database. Patients were followed to June 30, 2012 or until death. Follow-up time was dependent on the date of index surgery, ranging from 10 mo to 6 y. One abstractor reviewed the electronic medical records to retrospectively extract serum creatinine at 11 prespecified time points: baseline (defined as within 30 d before surgery), at time of discharge, 1 mo, 6 mo, 1 y, 2 y, 3 y, 4 y, 5 y postdischarge, last point of follow-up, and at first incidence of severe CKD. A random sample (30% of the cohort) was audited by a second reviewer to confirm accuracy of data extraction.

Patient sociodemographic and clinical information collected included body mass index (BMI), Charlson comorbidity index (excluding solid tumor),[17,18] diabetes, peripheral vascular disease, history of myocardial infarction within 6 mo, tumor staging based on the American Joint Committee on Cancer (seventh edition), tumor location (colon *versus* rectum), surgical approach (open *versus* minimally invasive), hospital readmission, and cause of readmission.

Perioperative management in relation to ileostomy care included ostomy teaching before discharge and education regarding high ostomy output; in general, patients were not discharged until ileostomy output was <1000 cc per 24-h period, and no intravenous fluids were required to maintain adequate hydration during the same time interval. Diet modification, fiber supplements, and escalating addition of medications such as loperamide hydrochloride, diphenoxylate hydrochloride/atropine sulfate, and opium tincture were used to facilitate management of high ostomy output during the perioperative period and at time of discharge, as necessary.

Outcomes

Patients were categorized based on whether a new ileostomy was created during their index operation. The two primary outcomes of interest were[1] AKI requiring readmission, within 1 y after the index discharge from surgery, and[2] severe CKD at 12 mo. For the first outcome, the reason for readmission was determined from direct review of the admitting and inpatient clinical notes within the electronic medical record. Any readmission because of an increase in the serum creatinine from the baseline value and clinical and laboratory findings consistent with dehydration was recorded as the outcome. For each patient readmitted for AKI, additional data were extracted: (1) highest serum creatinine during readmission, (2) serum creatinine at discharge from readmission, and (3) serum creatinine at 3 mo after discharge from readmission. Median differences in the change in serum creatinine are reported.

Severe CKD was defined as the first occurrence of drop in GFR under 30 mL/min/1.73 m^2 after discharge from the index operation that was followed by another GFR <40 mL/min/1.73 m^2 at least 3 mo apart. As per current guidelines, the Chronic Kidney Disease Epidemiology Collaboration formula, which incorporates serum creatinine, age, sex, and race, was used to calculate all values of GFR.[19]

Statistical analysis

Categorical data were compared using two-sided chi-squared test or Fisher's exact test. Continuous data were compared using independent sample t-test or Mann–Whitney U test for